clusions which he draws from them are so important, that we feel we should not have done justice to the communication, had we not given an abstract of the whole, at the same time that we stated our opinion of its value. Had the author's discovery consisted alone of the simple fact, that steel may be magnetised by a distant magnet, in a manner similar to that employed with the voltaic battery, we should have considered it of the highest importance in the inquiry concerning the connexion between magnetism and electricity; but when we see permanent effects which, hitherto, have only been derived from electricity, now derived from the common magnet, by calling in the aid of motion, showing clearly that electricity can thus be excited; and find that the laws which govern the phænomena are established, we cannot but entertain hopes that a door has been opened through which may at length be discovered the precise distinction between two agents which in many respects so greatly resemble each other in their effects and in their laws of acting. Such being our opinion of the results obtained by Mr. Faraday, we can have no hesitation in recommending most strongly the publication of his paper in the Transactions of the Royal Society.

(Signed) S. H. Christie.
J. Bostock.

Dr. Davy's Paper on the Torpedo, was then read in continuation.

April 12, 1832.

HIS ROYAL HIGHNESS THE DUKE OF SUSSEX, K.G. President, in the Chair.

The reading of Dr. Davy's Paper, entitled, "An Account of some experiments and observations on the Torpedo," was resumed and concluded.

The late Sir Humphry Davy gave an account, in a paper published in the Philosophical Transactions for 1829, of some experiments which he made on the Torpedo, with the view of ascertaining how far its electricity is analogous to that of the voltaic, or other galvanic batteries; but the results he obtained were altogether of a negative kind. He was prevented by the declining state of his health from prosecuting this inquiry, which he was still ardently bent upon completing, and which he requested his brother would carry on after his death. The author, accordingly, when at Malta, being in a favourable situation for obtaining living torpedos, made the series of experiments which are related in the present paper. They entirely confirm those of Mr. Walsh made in 1772, and which established the resemblance of the agency exerted by this fish to common electricity; and they also prove that, like voltaic electricity, it has the power of giving magnetic polarity to steel, of deflecting the magnetic needle, and also of effecting certain chemical changes in fluids subjected to its action. Needles perfectly free from magnetism were introduced within a spiral coil of copper wire, containing about 180 convolutions; the whole coil being an inch and a half long and one

tenth of an inch in diameter, weighing only four grains and a half, and being contained in a glass tube just large enough to receive it. On the electric discharges from a vigorous torpedo being made to pass through the wire during a few minutes, the needles were rendered strongly magnetic. The same influence transmitted through the wires of the multiplier produced very decided deflexion of the needle; the under surface of the electrical organ of the torpedo corresponding in its effect to the zinc plate of the simple voltaic circle, and the upper surface corresponding to the copper plate. No effect of ignition could be perceived when the discharge from the torpedo was made to pass through a silver wire one thousandth of an inch in diameter: nor could unequivocal evidence be obtained of the production of sparks on interrupting the circuit; the slight luminous appearances which occurred being probably of the same kind as those often exhibited by sea water when agitated. A small gold chain, however, composed of sixty double links, was found to be capable of transmitting the shock; a fact which seems to show that air is not impermeable to the electricity of the torpedo. When fine silver wires, interrupted by a solution of common salt, were placed in the circuit, minute bubbles of air collected round the point communicating with the under side of the torpedo, but none at the other point. When gold wires, instead of the silver ones, were used, gas was evolved from each of the extremities; but in greatest quantity, and in smaller bubbles, from the lower, than from the upper wire. With a strong solution of nitrate of silver, the point of the lower gold wire became black, and only two or three bubbles arose from it; the point of the upper gold wire remaining bright, and being surrounded with many bubbles. Similar, but less distinct, results were obtained by employing a strong solution of superacetate of lead.

The remainder of the paper is occupied with a detailed account of the anatomical structure of the electrical organs of the torpedo, and of the muscles that surround them. The texture of the columnar portions of those organs appears to be homogeneous, with the exception of a few fibres, probably branches of nerves, which pass into them. A large quantity of water, separable by evaporation, enters into their composition: and they undergo spontaneous changes more slowly than the muscles. They are incapable of contraction by any of the ordinary stimuli, and even that of an electric shock from a voltaic battery, applied either to the organs themselves or to the nerves which supply them. Hence the conclusion is drawn that these organs are not muscular, but that their columns are formed by tendinous and nervous fibres, distended by a thin gelatinous fluid.

The anatomical account is concluded by a description of the origin, course, and distribution of the nerves belonging to the electrical organs. The author found that the gastric nerves are derived from these; and hazards the conjecture that superfluous electricity may, when not required for the defence of the animal, be directed to the stomach, so as to promote digestion: in corroboration of which he cites the instance of a torpedo which, when living, had

been frequently excited to give shocks, and in whom a small fish found in its stomach after death, appeared to be totally undigested. The secretion of mucus was also either suppressed or considerably diminished. From the circumstance that the branchiæ are supplied with twigs of the electrical nerves, the author conceives there may be some connexion between the electrical and the respiratory functions; and that the evolved electricity may be employed in decomposing water, and in thus supplying the system with air, in situations where the animal has not access to that of the atmosphere. The author considers the mucous system of the torpedo as performing important offices in its economy, in consequence of its connexions with the electrical nerves. Contrary to the statement of Mr. Hunter, he finds that the electrical organs are very scantily supplied with blood-vessels. He concludes by some remarks on the peculiar characters of the electricity of the Torpedo, the purposes it appears to serve, and the varieties exhibited by different individuals, according to the age, the sex, and other circumstances.

The Meetings of the Society were then adjourned over Easter to the third of May.

May 3, 1832.

JOHN BOSTOCK, M.D. Vice President, in the Chair.

The following Report, drawn up by the Rev. William Whewell, M.A. F.R.S., the Rev. George Peacock, M.A. F.R.S., and the Rev. Henry Coddington, M.A. F.R.S., on Mr. Lubbock's Paper, read before the Royal Society Feb. 9, 1832, and entitled, "Researches in Physical Astronomy," was read.

Report.

The method of the variation of parameters as applied to the investigation of the perturbations of the solar system has been successively developed in modern times. This method gives the variations of the elements of the elliptical orbit in terms of the differentials of a certain function R of these elements, and of the disturbing forces. Euler, Lagrange (1783), Lagrange and Laplace (1808) obtained the formulæ for $d\alpha, de, d\varpi, dp, dq$ where $p = \tan\varphi \sin\theta, q = \tan\varphi \sin\theta$. Poisson first gave the expression for $d\varepsilon$. Pontécoulant, p. 330, has introduced $d\iota$ and $d\nu$ instead of dp and dq; but those developments gave expressions neglecting the square of the disturbing force. Mr. Lubbock has published (in a Paper in the Phil. Trans. April 1830,) expressions which include the effect of any power of the disturbing force. This method has been principally applied to the secular inequalities; but it is susceptible of being applied with no less strictness to periodical inequalities, all of which may be represented by certain changes in the elements of the elliptical orbit.

But the same problems may also be approximately solved directly; for we obtain a differential equation involving the radius vector and the time. In this equation there occurs the same func-